

國立成功大學

112學年度碩士班招生考試試題

編 號：154

系 所：生物醫學工程學系

科 目：材料科學

日 期：0206

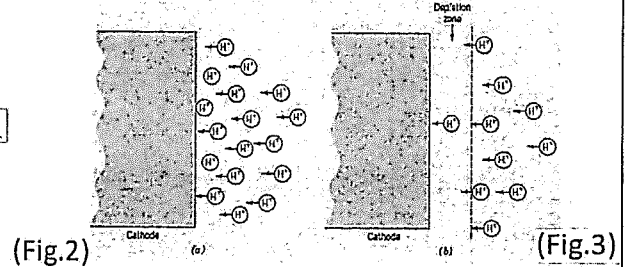
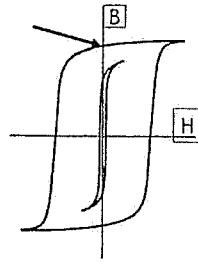
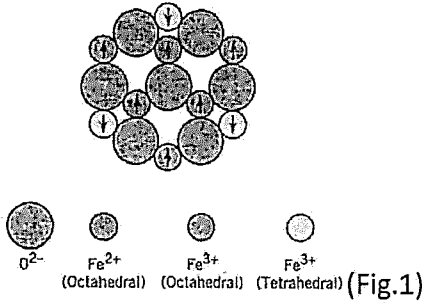
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備 註：可使用計算機

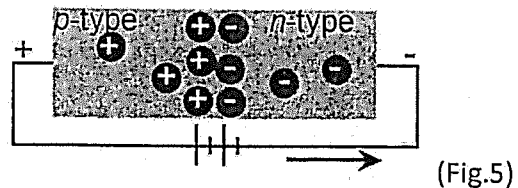
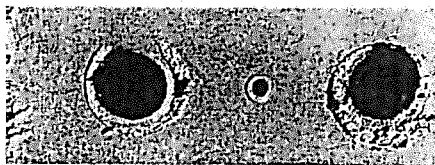
※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

I Multiple choice: (60 points, 1 point each)

- In generation of a magnetic field, $B = \mu H$, what is μ ? (A) Permittivity of a solid (B) Conductivity of a solid (C) Susceptibility of a solid (D) Permeability of a solid
- What phenomenon does Magnetic moments arise from? (A) Electron scattering (B) Electron orbital motion (C) Electron acceleration (D) Electron jumping between band gap
- What Magnetic Responses in this figure? (Fig.1) (A) Diamagnetic (B) Paramagnetic (C) Ferromagnetic (D) Ferrimagnetic

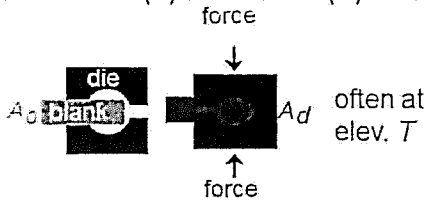


- In Hysteresis and Permanent Magnetization, what's the point the arrow indicates? (Fig.2) (A) Permittivity (B) Coercivity (C) Susceptibility (D) Remanence
- What phenomenon can be explained in the right hand of this figure? (Fig.3) (A) Activation polarization (B) Concentration polarization (C) Electromotive force (D) Overvoltage
- Which factor increase can decrease the resistivity of metal? (A) temperature (B) impurity (C) deformation (D) crystallinity
- What is produce a unit rise in temperature for one mole of a material. (A) heat capacity (B) thermal expansion (C) thermal conductivity (D) thermal shock resistance
- Which type of materials has the highest specific heat? (A) Polymers (B) Ceramics (C) Metals (D) Glass
- What parameter is not related to thermal shock resistance? (A) Fracture strength (B) Heat Capacity (C) Thermal expansion coefficient (D) Young's modulus
- What kind of corrosion in this figure? (Fig.4) (A) Crevice (B) Erosion (C) Pitting (D) Intergranular

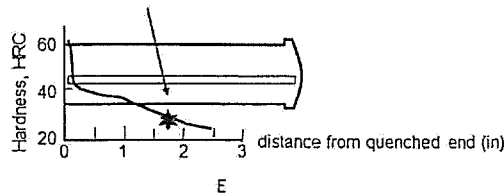


- What's the phenomenon in this figure? (Fig.5) (A) Extrinsic drift (B) Rectifying junction (C) Junction transistor (D) MOSFET
- What property is usually strong in fiber of composite? (A) Tension (B) Compression (C) Torsion (D) Shearing
- Reinforcement efficiency of fiber-reinforced composite for "any direction in the plane of the fiber(2D)" (A) 1 (B) 1/2 (C) 3/8 (D) 1/5
- The most important function of "matrix phase" in fiber-reinforced composite? (A) Reduce the weight (B) Increase the strength (C) Improve ductility (D) Transmit force to fiber
- Which forming method in this figure (Fig.6) (A) Rolling (B) Die casting (C) Forging (D) Investment casting

16. In this hardenability profile, what phase is formed at low hardness region? (Fig.7) (A)Austenite (B) Martensite (C) Cementite (D) Pearlite

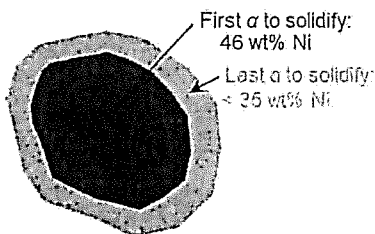


(Fig.6)

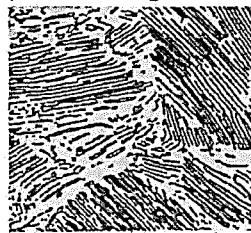


(Fig.7)

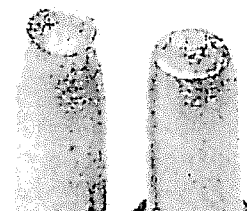
17. Which of the following is not usually added into polymers (A) Lubricant (B)Colorants (C) Plasticizer (D) Cooling agent
18. Which of the following defect is linear defect? (A) Interstitial atoms (B) Dislocation (C)Stacking Fault (D) Grain boundary
19. Which steel is relatively weak and ductile? (A) Stainless steel (B) low-carbon steel (C)medium-carbon steel (D) high-carbon steel
20. What's the common upper limit of carbon content for medium-carbon steel? (A) 0.25% (B) 0.4% (C) 0.6% (D) 1.40%
21. What is the main phase formed in cast iron different from steel? (A) Graphite (B)Pearlite (C)Ferrite (D)Cementite
22. Which character is NOT the required performance of superalloy? (A)Resistance to creep at high temperatures; (B)High toughness (C) Good surface stability (D) Corrosion resistance.
23. What's called for a state of equilibrium is never completely achieved (A)viscoelastic (B) plastic (C)congruent (D)metastable
24. What kind of Ti alloy is the most common type used for implant material? (A)Ti6Al4V (B) Ti5Al2Sn (C)Ti10V2Fe3Al (D) Ti7Nb5V
25. What reason caused the concentration gradient in new phase formation? (Fig.8)(A)High heating rate (B)low heating rate (C)high cooling rate (D)low cooling rate



(Fig.8)



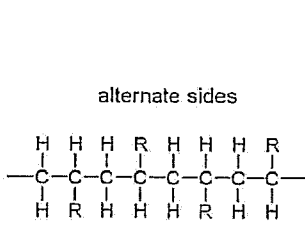
(Fig.9)



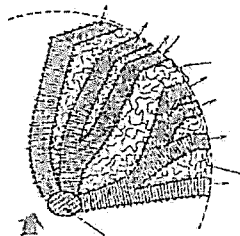
(Fig.10)

26. Name of this steel structure (Fig.9) (A)Austenite (B)Cementite (C)Ferrite (D)Pearlite
27. What kind of fracture in this picture (Fig.10) (A)Shearing (B)Ductile (C)Brittle (D)Compression
28. What's the K_c in this formula $K_c = Y(a/W)\sigma_c(\pi a)^{3/2}$ (A)critical resolved shear stress (B) stress intensity factor (C)fracture toughness (D)stress concentration factor
29. Which two parameters are used to measure "Creep" (A)Stress vs time (B) Strain vs time (C)Stress vs strain (D) Strain vs number of cycle
30. Which method can increase fatigue life? (A) Increase mean stress (B) Applied tension on material (C)Surface roughness (D) Shot peening
31. What's the **main reason** causing Plastic deformation of metal? (A) Dislocation density increase (B)Bond stretch (C)Bond rupture (D)Dislocation motion
32. Which of the following is NOT the source of NEW dislocation? (A) surface irregularities (B) grain boundary (C) internal defects (D) second phase
33. Which mechanical property directly related to Critical Resolved Shear Stress (A)Yielding stress (B)Ultimate tensile strength (C)Young's modulus (D)Fracture stress

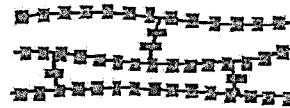
34. For FCC structure, which is slip plane? (A)(001) (B) (110) (C) (111) (D) (101)
35. What is the main reason for strain hardening from cold work (A) Grain size reduction (B) Grain boundary cancellation (C) Dislocation density increase (D)Lattice strain
36. The property can be recovered to prestressed state during annealing, which step is the most critical? (A) Recovery (B)Recrystallization (C) Strain harden (D) Temperature
37. What's the offset value used to find the yielding strength? (A) 0.2 (B) 0.02 (C) 0.002 (D) 0.0002
38. What character is used to describe the "ductility" of materials at fracture? (A)% elongation (B) % of energy absorption (C)Stress to cause failure (D) Force to cause failure
39. What's behavior causing the elasticity of metal? (A)Dislocation movement (B)Bond stretch (C) Slip (D) Solid solution
40. What test is usually used to measure the tensile properties of ceramics materials? (A)Flexural (B)Tensile (C) Shear (D)Torsion
41. For metal, why the "fracture stress" is usually **lower than "tensile strength"**? (A)Necking (B)Crack (C) Dislocation (D) Loading rate
42. The machine used to conduct testing for mechanical property of materials? (A)SEM (B) ASTM (C)MTS (D) X-ray
43. Which one is "not" the factor in Non-steady State Diffusion (A) Distance (B) Concentration (C)Temperature (D) Time
44. What is atomic migration in a pure metal (A) Interdiffusion (B) Self-diffusion(C) Interstitial diffusion (D) Vacancy diffusion
45. In diffusion mechanism, which factor usually will **not influence** the concentration of matter? (A)Charge (B) Time (C) Position (D) Temperature
46. What's the resolution range of optical microscopy? (A) 0.2 nm (B)2 nm (C)0.2 um (D)2 um
47. Which factor is the most important in Equilibrium concentration of vacancy? (A)Atomic weight (B)Valence electron (C) Activation energy (D)Atomic radius
48. What point defect in most "**unlikely**" happen in ceramic? (A) Cation interstitial (B)Anion interstitial (C) Cation vacancy (D)Anion vacancy
49. What's the most critical reason to have "**Nonstoichiometry**" formula? (A) Point defect (B) Two valance states (C) Linear defect (D) Interstitial
50. For a long carbon-carbon chain, what's the most possible angle between each bond (degree)? (A) 180 (B) 120 (C) 109 (D) 90
51. In molecular structure, what structure represent? (Fig. 11) (A) Configuration (B)Conformation (C)Shape (D)Tacticity



(Fig.11)



(Fig.12)



(Fig.13)

52. Name of semicrystalline polymer in this figure? (Fig.12)(A) Tacticity (B)Twisting (C)Spherulite (D)Amorphous
53. What molecular structure in this figure? (Fig.13) (A) Linear (B)Branched (C)Cross-linked (D)Network
54. What's the range of **radius of atom**? (A)0.01 nm (B)0.1nm (C) 1 nm (D)1 um
55. What's the molecular formation for secondary bonding forces? (A) Dipole (B)Ionization (C) Molecular weight (D) Polymerization

56. What phenomenon is **properties of materials vary** with crystallographic orientation? (A) Polymorphism (B)Crystallinity (C) Anisotropic (D)Amorphous
57. Which one is **NOT** the polymorphic form of **carbon**? (A) Perovskite (B)Graphite (C) Diamond (D) Fullerenes
58. The most critical reason to decide the **crystal structure in ceramics**? (A)Relative size between cation and anion (B)Defect type (C)Molecular weight ratio (D)Crystal structure of pure metal
59. What's atomic packing factor for BCC? (A) 58% (B) 68% (C) 74% (D) 76%
60. What's the most likely bonding type for Sodium chloride (NaCl) (A) van der Waals (B) Covalent (C) Metallic (D) ionic

II. Define the following terms: (1.5 pts each, 15 points total)

1. Alternating copolymer
2. Annealing
3. Dislocation line
4. Eutectoid reaction:
5. Fatigue life and fatigue limit:
6. Hardenability.
7. Mixed dislocation
8. Sacrificial anode
9. Specific modulus (specific stiffness):.
10. Tape Casting:

III. Essay and calculation (25 points total)

1. Pb-Sn is limited soluble to each other, so its phase diagram is a classical eutectic reaction, please **draw a eutectic phase diagram**? (4%)
2. Within a cubic unit cell, **sketch the following directions**: (4 %)
 - (a) $[\bar{1}10]$, (b) $[\bar{1}\bar{1}1]$, (c) $[\bar{1}22]$, (d) $[\bar{1}\bar{2}\bar{3}]$
3. Magnesium oxide has the rock salt crystal structure and a density of 3.58 g/cm^3 . **Determine the unit cell edge length**. (4%)
4. A sheet of steel 1.5 mm thick has nitrogen atmospheres on both sides at 1200°C and is permitted to achieve a steady-state diffusion condition. The diffusion coefficient for nitrogen in steel at this temperature is $6 \times 10^{-11} \text{ m}^2/\text{s}$, and the diffusion flux is found to be $1.2 \times 10^{-7} \text{ kg/m}^2\text{-s}$. Also, it is known that the concentration of nitrogen in the steel at the high-pressure surface is 4 kg/m^3 . **How far into the sheet from this high-pressure side will the concentration be 2.0 kg/m^3 ?** Assume a linear concentration profile. (4%) $J = -D \frac{C_A - C_B}{x_A - x_B}$
5. Please **draw a classic stress-stain curve of a ductile metal** under tension. Please define and point out on this curve for the following terms:
 - (1) stress (include unit)
 - (2) strain (include unit)
 - (3) Young's modulus (include unit)
 - (4) Yield stress
 - (5) Ultimate tensile stress. (9%)